BEST PRACTICE PROGRAMME

GOOD PRACTICE GUIDE 67

ENERGY CHAMPIONS:

A SELECTION OF

CASE HISTORIES

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

ENERGY CHAMPIONS

A SELECTION OF CASE HISTORIES

This booklet is No. 67 in the Good Practice Guide Series and is designed to encourage senior industrial decision makers to pursue effective energy management policies. The Guide details eight case histories of individuals - "Energy Champions" - who have successfully introduced energy saving measures into their company and in many cases achieved considerable savings.

Prepared for the Energy Efficiency Office by:

The Energy Technology Support Unit (ETSU)
Harwell
Oxfordshire
OX11 0RA

and

Briar Associates
Mill Lane
Kinver
Stourbridge
DY7 6LH

First published 1992

Other titles in the Good Practice Guide Series

1. GUIDANCE NOTES FOR THE IMPLEMENTATION OF SMALL-SCALE PACKAGED COMBINED HEAT AND POWER
2. GUIDANCE NOTES FOR REDUCING ENERGY CONSUMPTION COSTS OF ELECTRIC MOTOR AND DRIVE SYSTEMS
3. INTRODUCTION TO SMALL-SCALE COMBINED HEAT AND POWER
13. GUIDANCE NOTES FOR THE IMPLEMENTATION OF HEAT RECOVERY FROM HIGH TEMPERATURE WASTE GAS STREAMS
14. RETROFITTING AC VARIABLE SPEED DRIVES
17. GUIDANCE NOTES FOR ACHIEVING HIGH YIELDS IN IRON FOUNDRIES
18. REDUCING ENERGY CONSUMPTION COSTS BY STEAM METERING
30. ENERGY EFFICIENT OPERATION OF INDUSTRIAL BOILER PLANT
31. COMPUTER AIDED MONITORING AND TARGETING FOR INDUSTRY
36. COMMERCIAL REFRIGERATION PLANT: ENERGY EFFICIENT OPERATION AND MAINTENANCE
37. COMMERCIAL REFRIGERATION PLANT: ENERGY EFFICIENT DESIGN
42. INDUSTRIAL REFRIGERATION PLANT: ENERGY EFFICIENT OPERATION AND MAINTENANCE
43. INTRODUCTION TO LARGE-SCALE COMBINED HEAT AND POWER
44. INDUSTRIAL REFRIGERATION PLANT: ENERGY EFFICIENT DESIGN
47. RUBBER COMPOUNDING IN THE RUBBER PROCESSING INDUSTRY
49. ENERGY EFFICIENT LADLE PRE-HEATING TECHNIQUES WITHIN THE STEEL INDUSTRY
50. GUIDANCE NOTES FOR THE EFFICIENT OPERATION OF CORELESS INDUCTION FURNACES
60. THE APPLICATION OF COMBINED HEAT AND POWER IN THE UK HEALTH SERVICE
63. METAL DISTRIBUTION AND HANDLING IN IRON FOUNDRIES

Copies of these guides may be obtained from:

Energy Efficiency Enquiries Bureau
Energy Technology Support Unit (ETSU)
Harwell
Oxfordshire
OX11 0RA
Tel No: 0235 436747.Fax No: 0235 432923. Telex No: 83135

Overseas customers please remit £3 per copy (minimum of £6) with order to cover cost of packaging and posting. Please make cheques, drafts or money orders payable to ETSU.

FOREWORD

This guide is part of a series produced by the Energy Efficiency Office under the Best Practice programme. The aim of the programme is to advance and spread good practice in energy efficiency by providing independent, authoritative advice and information on good energy efficiency practices. Best Practice is a collaborative programme targeted towards energy users and decision makers in industry, the commercial and public sectors, and building sectors including housing. It comprises four inter-related elements identified by colour-coded boxes for easy reference:

— *energy consumption guides*: (blue) energy consumption data to enable users to establish their relative energy efficiency performance;

— *good practice guides and case studies*: (red) independent information on proven energy saving measures and techniques and what they are achieving;

— *new practice projects*: (green) independent monitoring of new energy efficiency measures which do not yet enjoy a wide market;

— *future practice R&D support*: (purple) help to develop tomorrow's energy efficiency good practice measures.

If you would like any further information on this document, or on the Best Practice programme, please get in touch with your Regional Energy Efficiency Office. Their addresses are given below:

ENGLAND

Energy Efficiency Office (East Midlands Region)
Severns House
20 Middle Pavement
Nottingham
NG1 7DW
Tel: 0602 596379

Energy Efficiency Office (Northern)
Department of the Environment
Wellbar House
Gallowgate
Newcastle upon Tyne
NE1 4TB
Tel: 091 232 7575

Energy Efficiency Office (North West Region)
Sunley Tower
Piccadilly Plaza
Manchester
M1 4BA
Tel: 061 838 5335

Energy Efficiency Office (South Eastern Region)
Room 221
Bridge Place
88/89 Eccleston Square
London SW1V 1PT
Tel: 071 215 0619

Energy Efficiency Office (Eastern Region)
Room 216
Bridge Place
88/89 Eccleston Square
London SW1V 1PT
Tel: 071 215 0610

Energy Efficiency Office (South and West)
The Pithay
Bristol
BS1 2PB
Tel: 0272 272666 ext. 437

Energy Efficiency Office (West Midlands Region)
77 Paradise Circus
Queensway
Birmingham
B1 2DT
Tel: 021 212 5134

Energy Efficiency Office (Yorkshire & Humberside Region)
25 Queen Street
Leeds
LS1 2TW
Tel: 0532 338285

Energy Efficiency Office (NORTHERN IRELAND)
Economic Development Dept.
Netherleigh
Massey Avenue
Belfast
BT4 2JP
Tel: 0232 763244 ext. 2377

Energy Efficiency Office (SCOTLAND)
Scottish Office Industry Dept.
Energy Division R6/58
New St. Andrew's House
Edinburgh
EH1 3TG
Tel: 031 244 4665

Energy Efficiency Office (WALES)
Industry Department
Welsh Office
Cathays Park
Cardiff
CF1 3NQ
Tel: 0222 823126

CONTENTS

FIGURES **Page No.**

ENERGY CHAMPIONS - A SELECTION OF CASE HISTORIES

1. INTRODUCTION

1.1 Purpose of the Guide

The purpose of this Guide is to show, through a series of case histories, the achievements of senior industrial decision makers in energy efficiency, and thereby encourage others to pursue their achievements with similar courses of action.

It is a fact that the most cost effective energy saving device of all is the "Energy Champion" or effective individual; usually a senior decision maker whose drive and commitment ensures efficiency in all areas of the company. Experience has shown that without a commitment from the top, potential cost savings resulting from energy saving are never fully realised.

The case histories cover a range of company size and concentrate on the management techniques that can be used in achieving energy savings. Often such techniques result in considerable cost savings when finances available for technical improvements to plant and equipment are limited.

The case histories also demonstrate different, sometimes conflicting approaches to energy management. There is obviously no right or wrong approach. Companies pursued policies which they perceived to be right for them, depending on their management culture and company conditions.

1.2 Importance of Energy Efficiency

It is currently estimated that a fifth of the nation's energy bill, a staggering £10 billion, could be saved annually. In individual companies the potential saving, which is converted directly into profit, can often reach 30% with 10% often being achievable for no cost.

The synergy between energy and environmental issues provides a further reason for pursuing energy efficiency. Environmental issues are increasingly exerting legislative and marketing pressures on energy efficiency. The improvement of processes in order to meet the Environmental Protection Act often has implications on energy efficiency. Consumer awareness of environmental issues puts pressure on manufacturers to demonstrate that their products are produced in an environmentally acceptable manner. This has led to many companies developing a clear environmental and energy policy.

The Department of the Environment's "Making a Corporate Commitment" Campaign and future energy accreditation schemes can also be seen as important "environmentally friendly" marketing tools.

Attention to energy efficiency is often found to have had a surprisingly profound effect on a company's development with improvements to working conditions, enhanced production capabilities (particularly for thermal processes) and increased staff participation and commitment to the works.

2. MANAGEMENT TECHNIQUES IN ENERGY EFFICIENCY

Installing energy saving equipment or state of the art plant is one way of achieving significant energy savings but often requires significant capital investment. However, there is usually as much to be gained, at little financial cost, from dedicating a little management time to the techniques described below.

2.1 Monitoring and Targeting (M&T)

Manuals on the implementation of M&T in most industrial sectors have been published by the Energy Efficiency Office through trade associations (for further information, see Section 11). Essentially M&T involves relating the energy consumption of discrete units within a site, such as a furnace, production line or heating system, to a variable such as production throughput or degree days (a measure of weather conditions). From this relationship, unexpected increases in energy consumption can be rapidly identified and targets for improved performance set.

Essential to the success of M&T is the action taken to ensure that these targets are met and that unexpected increases in energy consumption are corrected. To operate effectively, M&T must be portrayed positively to encourage staff involvement and ownership of the energy issue, rather than being used negatively to pursue the culprit. The case histories demonstrate that the most successful M&T is where all employees are encouraged and gain praise for positive performance (the carrot rather than the stick approach).

M&T often results in savings of 10% or more and was used effectively in Case Histories 1, 2,3,4, 5 and 8.

2.2 Staff Awareness and Motivation

In most companies almost all employees can assist in improving energy efficiency through improved housekeeping measures. In order to enlist their help it is first necessary to increase awareness, and this can be achieved by a variety of methods; internal seminars, poster campaigns, newsletters, competitions, or the use of devices such as mascots to represent energy efficiency.

Motivation towards energy saving can be maintained in numerous ways including; inter departmental competitions, prizes for departments achieving the greatest savings, suggestion schemes, and donation of a percentage of the savings to a charity of the staff's choice. By far the most effective strategy to increase awareness and motivation however, is to make departmental managers or supervisors accountable for the energy that they use. Staff awareness and motivation campaigns were used in Case Histories 1,2, 5 and 6 and are discussed in more detail in Refs 3, 4 and 5.

2.3 Staff Training

Training in energy efficiency is ongoing and is carried out in a variety of ways to suit different levels of staff (Refs 4 and 5). For production managers, supervisors and other production staff, in-house courses in energy efficiency may be run by the Energy Manager. For personnel operating specific items of plant, such as furnaces and boilers, training is available from equipment suppliers or Consultants. For the Energy Manager, courses in Energy Engineering or Fuel Technology are provided by a number of universities and polytechnics. For continuing career development short courses covering specialist topics are provided by professional bodies and trade associations.

In-house training courses for all levels of staff, tailored to the particular company requirements are offered by many Consultants. Technical staff may keep abreast of the latest technology through seminars throughout the UK run by the Department of the Environment and through membership of regional energy management groups.

Staff training was used in Case Histories 2 and 7, and is discussed in more detail in Refs 4 and 5.

2.4 Manufacturing

Careful examination of how the manufacturing process works can reveal opportunities for energy saving. Areas which should be considered include:

- The purchase price of fuel used in the process;
- The way in which fuel is used to produce the finished product;
- Life cycle costing when purchasing new plant (Refs 6 and 7);
- Planned maintenance of plant and central services such as steam and compressed air;
- The way in which production is organised.

Detailed consideration of the manufacturing process resulted in energy savings in Case Histories 1, 4, 5, 6, 7 and 8.

2.5 Quality

For most organisations BS5750 accreditation is of considerable importance and the introduction of Total Quality Management (TQM) is increasingly common in the manufacturing environment. TQM aims to minimise waste in all areas of a company's operation and there is no reason why it should not include energy. The use of quality circles to consider energy efficiency can be invaluable and in some cases, the results have been exceptionally successful with the energy quality circle providing more benefit than circles viewing other production issues. Energy was included in the TQM programme in Case Histories 1, 2 and 6, and TQM is discussed in detail in Refs 8, 9, and 10.

2.6 Finance for Energy Saving Schemes

Often savings of the order of 10% of the total energy bill can be achieved for no capital cost and securing these savings is usually the first priority. A proportion of the savings can later be invested in schemes requiring modest investment in order to secure further savings to yield a progressive self-funding programme. Alternatively, in situations where an annual budget is set for the purchase of energy, any reduction in actual spend compared with the budget figure can be invested in low-cost schemes.

This also acts as an incentive towards good housekeeping. The self financing of energy saving schemes is demonstrated in Case History 8.

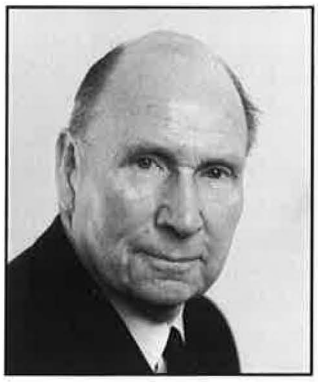
In situations where larger schemes providing acceptable payback periods have been identified, but the capital required for implementation is not available, Contract Energy Management (CEM) provides a good solution. Here the CEM company provides the capital required and implements the scheme. There are several variations on contractual arrangements between a CEM company and the client, but essentially the investment is recovered by sharing the savings with the client. CEM is discussed in more detail in Refs 11, 12 and 13 and was used in Case Histories 4 and 7.

Summary of case histories and management techniques

Energy Champion/ Company	Company	Est Annual Energy Costs	Energy Intensity Energy % of Turnover
Peter Armitage Birmid Qualcast	Engineering	£1.8 m	1%
David Pearson Rockware Glass	Glass	£5 m	12%
Cedric Rodrigues GEC	Engineering	£5 m	0.5%
Christopher Johnson Wedgwood	Ceramics	£5.5 m	2.1 %
John Pilling Brintons Ltd	Carpets	£2 m	2.7%
Peter Haythornthwaite Fisons Scientific Equipment	Fine Chemical	£0.3 m	1%
Peter Crawford Automotive Products	Engineering	£1.5 m	1.1%
David Holdsworth J.Holdsworth & Co	Textile	£0.1 m	1%

3. CASE HISTORY 1 - PETER ARMITAGE - BRAY TECHNOLOGIES plc

CAREER HISTORY



Peter Armitage has held many senior positions during his career, including:

General Manager - GEC Traction
Managing Director - GEC Switch Gear
Managing Director - GEC Transformers
Main Board Director - Birmid Qualcast plc
Chairman - Potterton International Ltd
Chairman - API Group plc
Chairman - Bray Technologies plc

"IF WE DO NOT SPEND ANOTHER PENNY OR ACHIEVE ANY FURTHER SAVINGS IN ENERGY MANAGEMENT, THE WORK WE HAVE DONE SINCE 1979 HAS BEEN OF INESTIMABLE VALUE TO THE COMPANY"

3.1 Introduction

Throughout a long and distinguished career in management, Peter Armitage has acted vigorously to eliminate waste in all levels of the organisation under his control. This has included the incorporation of Just In Time, Material and Requirements Planning, Statistical Process Control, and Total Quality Management, (sometimes known as Company Wide Continuous Improvement), as routine parts of cost control in manufacturing and service operations. It is unusual to find energy saving included within their structured approach, and involving all levels of management. However, Peter Armitage has always regarded energy as demanding such status, not to be displaced by other short term pressures which arise to dominate a manager's attention.

Over the past 13 years, this approach has led to savings in excess of £2.5 million/year in companies for which he has had direct responsibility. These savings led naturally, through his public addresses and private advice, to further savings approaching £6 million/year in other companies within the Birmid Qualcast group.

The soundness of his approach led to invitations for Peter Armitage to speak at the National Energy Management Conference and at EEO events throughout the country, leading to him being the first industrialist to speak at the initial EEO "Breakfast Special" of Monergy Year 1986. Here he attracted at least one major engineering group to seek further advice with resulting savings for them exceeding £500k without significant capital investment. The Energy Manager of one of his companies (Jim Bruder of Potterton International) received an award in the prestigious National Energy Manager of the Year competition in 1982.

3.2 Motivation Towards Energy Saving

In 1979, whilst holding the post of Chairman and Chief Executive of the Heating, Engineering and Electronics Division of Birmid Qualcast, and also main board director of the group, Peter Armitage set up a team to report on the potential for improving the performance of companies in his divisions. The target was to eliminate waste in all aspects of their operations. On receiving the team's report he was concerned that they had completely ignored the potential for energy savings, an area of increasing importance since the recent rapid rise in fuel prices which seemed likely to continue. He regarded this omission as critical, particularly since in his words "Substantial savings without the need for capital investment were as easy as shooting fish in a barrel."

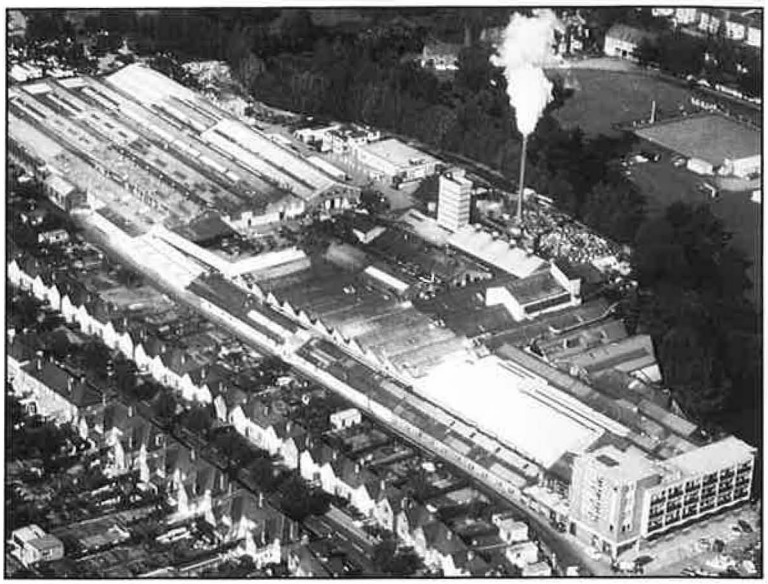


Fig 1 Potterton International, Leamington Spa

3.3 Energy Saving Seminar

He promptly contacted the EEO to discuss how awareness might be improved and they arranged a seminar for the executive managers of his companies. This made clear the extent of savings which were theoretically possible and covered some details of the approach by which they could be achieved. The importance of appointing specific persons to be responsible for energy management in each company was particularly stressed.

Knowing that in the scenario of cost savings, energy could loom large or small in different companies, Peter Armitage determined the appropriate priorities for his divisions in discussion with the executive managers after the seminar. The decision was to initiate a division-wide campaign by appointing Energy Coordinators for each company.

3.4 Appointment of Energy Coordinators

Whilst it was appreciated that Energy Coordinators could come from any discipline, after careful thought it was decided to select from managers with experience in cost control. As key people, they would need sound engineering skills, good communication ability, experience in dealing with other disciplines and the capacity to create enthusiasm in others so sustaining motivation throughout their companies.

For the Energy Coordinators a second, more detailed, seminar was arranged, in which the EEO and a firm of Consultants covered aspects of energy audits, monitoring and opportunities for energy savings. To reinforce the importance of this work Peter Armitage chaired the event. With staff now better equipped to identify potential energy savings, he ordered a full energy audit at each company.

3.5 Energy Audits

The Energy Coordinators were requested to produce complete energy audits for their companies and to identify savings that could be achieved within six months on revenue expenditure only - the good housekeeping aspects of energy efficiency. Their reports were submitted to Peter Armitage through company Managing Directors for discussions at Board level.

There was some variation in the company responses - both in terms of identifying savings opportunities and in the ability to deliver those savings within the six month period. One company, Potterton International, had identified short-term savings of 16% (£90k from an energy bill of £550k) compared with 5% - 12% in the other five companies. Moreover, the measures to achieve these savings were in place within the prescribed period.

During this period of critical examination of energy management within his companies, Peter Armitage identified the following reasons for poor performance:

- lack of information;
- failure to replace temporary expedients with efficient permanent arrangements;
- lack of ideas;
- lack of time spent on quantifying and evaluating options;
- honestly held wrong beliefs;
- long-standing ingrained habits and attitudes;
- fear of personal loss and criticism.

These areas had to be addressed, and this was largely achieved by the appointment of a Divisional Energy Coordinator to whom the company Energy Coordinators had access for advice and information.

3.6 Management Structure

Peter Armitage recognised the need for a structured approach to energy management, and elected to appoint a Divisional Energy Coordinator with a direct line of communication to himself. The Energy Coordinator of Potterton International, Jim Bruder, was appointed to this post, and was required to report each month to Peter Armitage.

The need for cooperation between the managerial, financial and technical disciplines within each company was addressed by forming an Energy Action Group. These groups involved different levels of staff within each company, and formalised the fact that Energy Management had ceased to be a talking point. It had become a reality from which clear results were expected.

The Energy Action Groups set about:

- communicating objectives to the widest possible cross-section of each company;
- brainstorming individuals views;
- identifying projects and ranking them in order of priority for action;
- establishing routes for the flow of information;
- agreeing procedures for performance-monitoring and the setting and revision of targets.

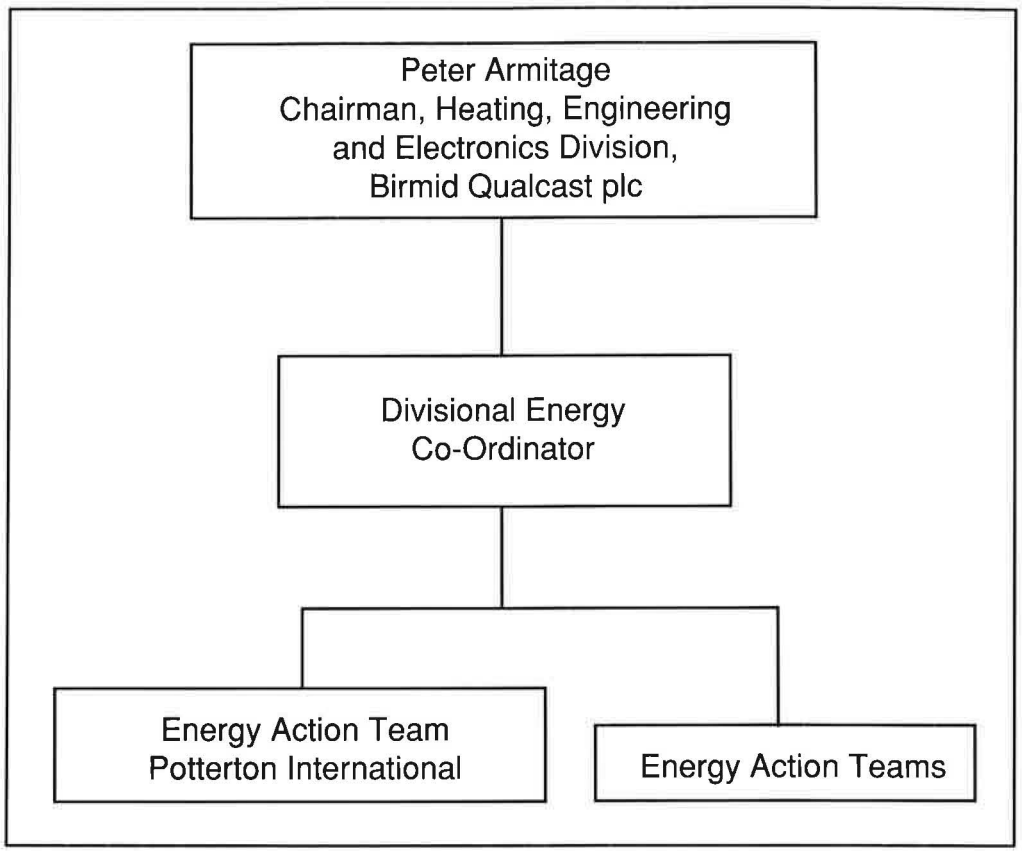


Fig 2 Management structure

A typical Energy Action Group would be chaired by a Director or the Divisional Energy Coordinator, and include: Purchasing Manager, Management Accountant, Works Engineer and Energy Coordinator.

An important feature of this structured approach to Energy Management was the flow of ideas from all levels of each company to the top. For the first two years of the campaign each Energy Action Group would meet monthly, and a divisional energy meeting chaired by Peter Armitage was held quarterly.

3.7 Monitoring and Targeting (M&T)

Once energy consumption was accepted as a controllable cost it was necessary to account for legitimate variations in demand arising from differing levels of production and environmental energy requirement. The statistical tool for this purpose was Monitoring and Targeting (M&T). An important feature of which was the setting of realistic targets for improved performance, and their regular revision to match a changing situation. M&T was initially carried out manually which proved somewhat crude and rather time consuming. Nevertheless it provided a meaningful flow of information to all levels of the workplace, in particular to the Divisional Chairman.

With the ability to quantify savings resulting from the improved management of energy came a policy of re-investing a proportion of the savings in further energy related projects. This had the effect of sustaining the motivation of the Energy Coordinators, and an early project which eased their work load was the introduction of computerised Energy Management. Birmid Qualcast was the host company, supported by Peter Armitage, to develop a group-wide computerised M&T programme.

3.8 Manufacturing Equipment

It became routine for companies within the group to insist that suppliers of new equipment give an energy statement in terms of absolute consumption and efficiency of control, to enable life cycle costs to be considered prior to purchasing. Machine maintenance and maintenance of services such as compressed air were the subject of individual attention in each company.

3.9 Staff Motivation

Once the standards of efficiency had reached a high level, and new savings were producing only an extra 2% to 3% of the total energy bill, staff motivation was sustained by a poster campaign. Novel, customised posters were produced by the Divisional Energy Coordinator, carrying the message "Every One Their Own Energy Manager". Individual motivation was enhanced by a staff suggestion scheme with cash prizes and by an internal Energy Coordinator of the Year competition for the Energy Coordinators themselves. The latter was judged by an external expert and the award was presented by an invited personality at a Head Office luncheon.

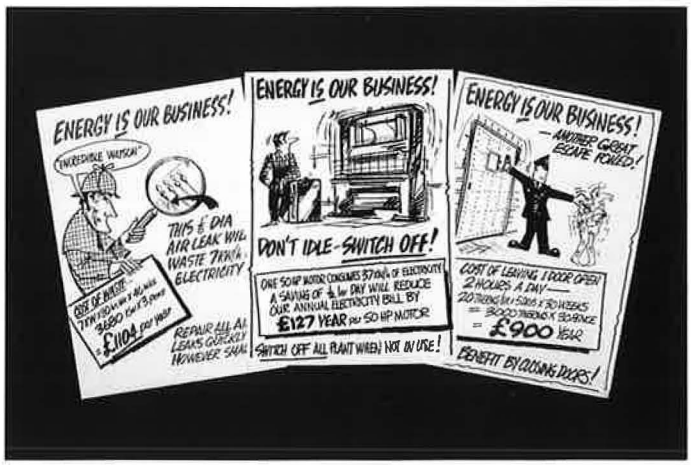


Fig 3 Typical energy efficiency posters

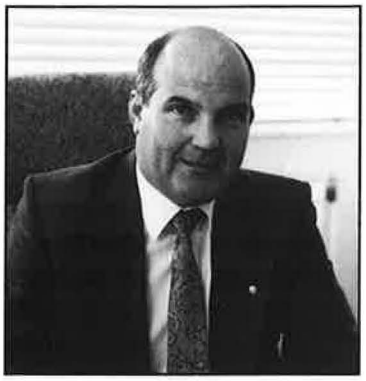
3.10 Summary

The starting point of Peter Armitage's contribution to energy efficiency was his clear recognition that energy costs are controllable. He has brought the management of these costs into the culture of every company with which he has been associated. In his view, energy efficiency can be justified on financial grounds alone, whilst in his experience there are always worthwhile non-financial benefits.

Implementation of his ideas is based on personal commitment and enthusiasm. He spreads this attitude downwards from the top of the organisation whilst perhaps turning the management tree upside down in his search for ideas. Strong but informed support for those at any level who have been given the responsibility in energy matters is a key element of his approach. His achievements are testimony to the effectiveness of reviewing standard procedures as a route to discovering improvement opportunities. The similarities between his approach to energy usage and the philosophy of Total Quality Management are obvious. The results most easily identified with his approach come from his period as Chairman of Potterton International, where the documented savings between 1979 and 1985 were 48% of the initial energy costs in real terms. Other companies in the Engineering and Electronics division had average savings of 20% over the same period. The approach has continued in other companies where substantial savings have accrued but precise figures have not been published.

4. CASE HISTORY 2 - DAVID PEARSON - ROCKWARE GLASS

CAREER HISTORY



David Pearson joined Jackson Brothers Glass Manufacturers in 1960. In 1976 following the Company's take over by Rockware Glass he was appointed Technical Development Manager at Group Headquarters. In 1979, he became Director of Production and Engineering at the Group's Wheatley factory and moved to the Knottingley factory in the same capacity at the in 1987. Since April 1992, he has been the Company Manufacturing Director.

"IF WE DO NOT SAVE THREE TIMES THE ENERGY OFFICER'S SALARY THERE IS SOMETHING WRONG. IDEALLY I AM LOOKING TO SAVE TEN TIMES THE ENERGY OFFICER'S SALARY."

4.1 Introduction

David Pearson is currently responsible for Manufacturing at Rockware's plants in Wheatley, Worksop, Knottingley and Portland. Six hundred process staff are employed at the Knottingley sites and the combined energy bill is approximately £5 million. The sites manufacture glass containers for the food and beverage and cosmetics markets and have a turnover of approximately £40 million.

Working in this energy intensive industry for over 30 years, he has contributed a great deal towards energy efficiency through his work on furnace and process development. This work has resulted in increased furnace life, reduced product defects and substantial energy savings in the UK and overseas.

Through his involvement at the Knottingley sites since 1988, the total energy consumption per unit of production output has been reduced by 12.5%, yielding annual savings of approximately £620,000, yet this level of saving has been achieved through improved working practices with negligible capital investment. The precedent set by him of appointing Energy Officers has spread through the group and has led to total savings estimated to be worth approximately £2 million/year for the Group.

4.2 Involvement in Energy Management

During the mid 1980s, David Pearson represented Rockware on the Energy Efficiency Office Committee working on the development of Monitoring and Targeting (M&T) in the glass making industry. This led to a polytechnic student being appointed as Energy Officer at the Wheatley site, to operate an M&T system, during her industrial training period. This was repeated the following year and its success led to David Pearson appointing a full time energy officer to cover the Knottingley sites in 1988. Energy Officers are now in place at all Rockware sites.

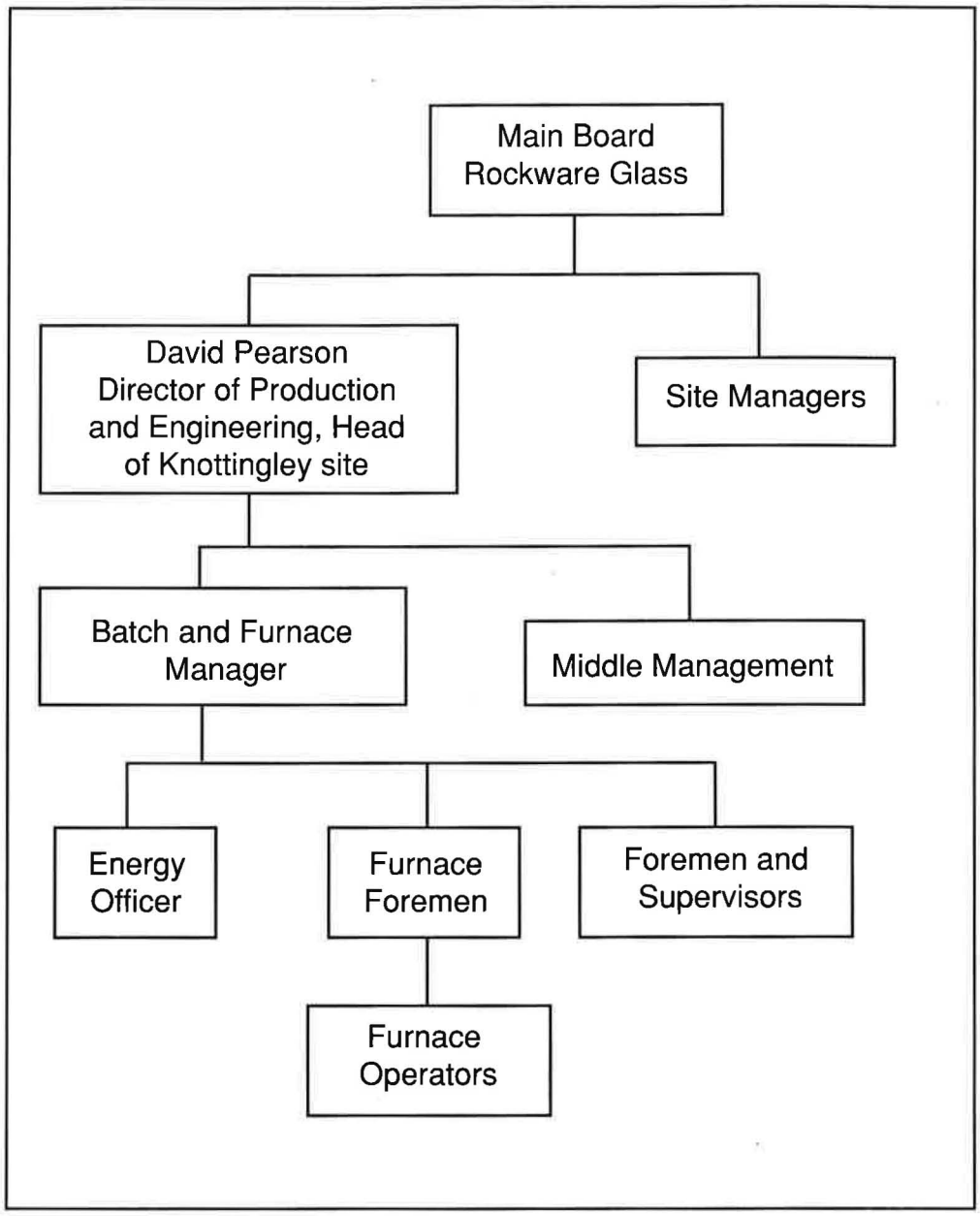


Fig 4 Management structure

4.3 Monitoring and Targeting (M&T)

When M&T was introduced at Rockware's Wheatley Site in 1985, a decision was made to concentrate on the furnaces as they consumed approximately 75% of the site's energy, this approach realised savings of 10% of the total site's energy bill.

After moving to the Knottingley Site, David Pearson commissioned Consultants to carry out a full energy audit at the site. The audit revealed that the fore hearths and lehrs represented a substantial energy cost and the M&T system was extended to cover fore hearths and lehrs. The energy consumption of the fore hearths and lehrs was dependent upon the weight of product produced and the operating temperature. Future energy consumption was therefore predicted from a mathematical equation incorporating these two variables. Whilst

mathematically correct the shortcoming of this approach lay in the inherent difficulty of communicating the theory to the fore hearth and lehr foremen. Consequently they had no confidence in predictions made and were reluctant to cooperate in finding reasons for variance from the predicted energy consumption.

4.4 Refinement of the M&T System

David Pearson therefore instructed his Energy Officer, Joanne Brooks, to look at other ways of applying M&T. Her solution was to identify individual energy consumption targets based solely on the weight of product produced for each product type and on each production line. The simplicity of this approach was more easily understood by foremen who were then more able to identify any variations in energy efficiency, and cooperate to a far greater extent in identifying reasons for variances.

David Pearson considers it was the constant search for reasons for variance in performance, identification of incidents of good practice, and the cooperation of production foremen that was the key to much of the success at the Knottingley site. This continued analysis and improvements to working practices ultimately achieved energy savings of up to 50% at some of the fore hearths.

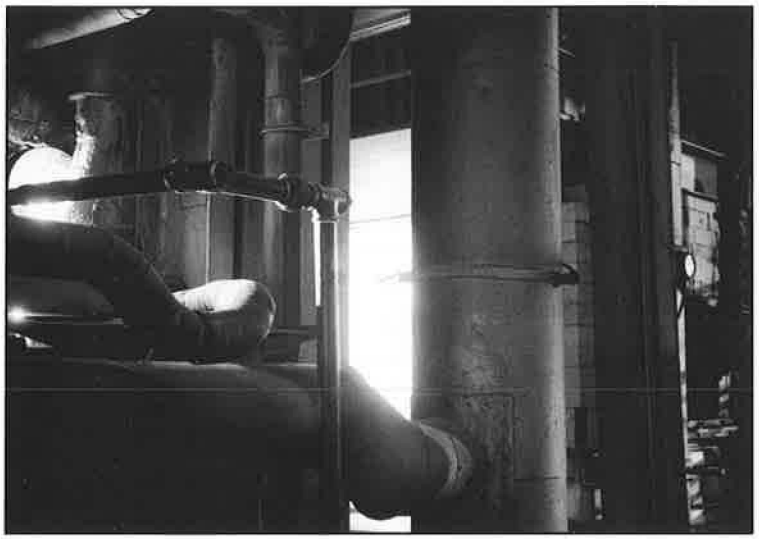


Fig 5 A typical Rockware furnace

4.5 Flow of Information

A comprehensive reporting system was set up so that David Pearson and the furnace manager both received weekly and monthly energy reports, followed by an annual summary report. All shift foremen received a detailed weekly report showing the performance of each item of plant and daily reports were presented to foremen and plant operators on each production line. The latter was of particular importance as it allowed rapid action to be taken to rectify any incidents of poor performance identified by the M&T system.

In 1988, the importance of sharing ideas and experience gained at individual sites with all sites within the Rockware Group was recognised. Bi-monthly meetings of all site Energy Officers were arranged through the Rockware Central Technical Centre. The meetings have continued to the present day and been of great value to the Group, with the minutes of each meeting being sent to each site manager and each furnace manager.

4.6 Awareness and Motivation

In the early days a limited poster and sticker campaign was operated to increase general energy awareness. However, the main thrust towards employee awareness and motivation was carried out through the M&T system. The daily feedback of information to foremen and plant operators demonstrated that their efforts were having a significant effect on energy consumption and this proved to be a great source of motivation.

The cooperation of foremen and plant operators was gained through discussion and persuasion rather than setting targets and demanding that they were met. The success in this area was undoubtedly increased by the knowledge of David Pearson's keen interest and commitment to energy efficiency.

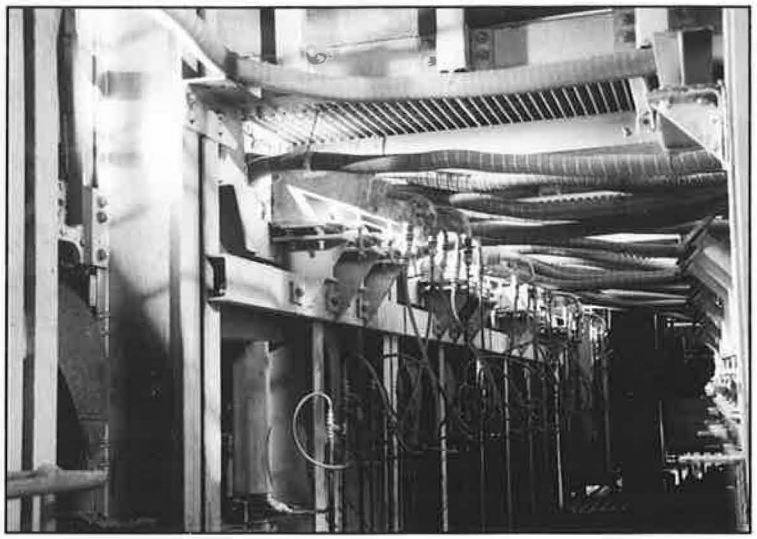


Fig 6 Process plant

4.7 Training

In 1990, it was decided to include a half hour period on energy efficiency in routine training courses for plant operators. During such courses the Energy Officer increased awareness by indicating many ways in which the operators could reduce energy consumption. Quantifying the cost of wastage from compressed air leaks etc., was an important feature of the training as was the use of charts and graphical representation of the sites success in energy conservation.

Prior to training, employees were often unaware of the cost of energy wastage and were therefore not motivated towards its elimination. This fact was highlighted during the energy training sessions when the Energy Officer asked plant operators to guess the site's energy bill, and many replies were as low as 1% of the actual value.

Training of the Energy Officer has also been important. David Pearson recruited an Energy Officer with a degree and on-going training and updates on new technology have been achieved through attendance at seminars organised by the Energy Efficiency Office.

4.8 Total Quality Management (TQM)

Rockware has been actively involved in TQM for some time, and David Pearson has been committed to integrating energy into TQM and has used quality teams to find solutions to particular problems. A good example of this was when staff walked out because of low ambient temperatures in one area of the factory. The quality team formed to solve this problem included the Energy Officer, Works Engineer, the Shop Steward who led the walk out, and staff in the area concerned. The solution of constructing an internal wall, replacing warm air heaters with radiant heaters, and installing fast acting doors over fork lift access points not only satisfied comfort requirements but also significantly reduced energy consumption. Due to the five shift system operated at the site to facilitate continuous operation, several of the furnace operators rarely see each other. Efforts are now being made to arrange a monthly meeting of all furnace operators, in line with TQM philosophy, to facilitate the exchange of ideas and enable a strategy to be produced for all operators to follow.

4.9 Summary

Over the years, David Pearson has made a significant contribution to energy efficiency. His work on the development of glass manufacturing technology has contributed to energy saving in the UK and overseas.

His participation in the Energy Efficiency Office's development of M&T in the glass making industry and his appointment of Energy Officers at Rockware has led to significant savings for the Group, an estimated £2 million/year. This achievement is all the more remarkable since it has been realised through a commitment to developing a specific M&T system that has enabled analysis of the effect of working practices on energy efficiency and has therefore been achieved with minimal capital investment. However, he believes that there still remains much to be saved through Energy Management within the Group.

5. CASE HISTORY 3 - DR. CEDRIC RODRIGUES - GEC PLC

CAREER HISTORY

Since 1976, Cedric Rodrigues has held various research and management positions within GEC. In 1986, he was appointed Group Energy Adviser responsible directly to the Board of Directors and has recently combined this role with group environmental management.

"EVERY ONE POUND OF ENERGY COST SAVED GENERATES A NET PROFIT EQUIVALENT TO GOING OUT AND FINDING TEN POUNDS OF NEW BUSINESS, NOT JUST FOR ONE YEAR BUT FOR EVERY YEAR THEREAFTER"

5.1 Introduction

GEC is the UK's leading producer of electronic, electrical, and power generation equipment. The Group occupies some 150 manufacturing sites throughout the UK and its products range from domestic appliances to communications satellites.

The Group's operations are not energy intensive, with energy representing less than 5% of raw material costs. However, the importance placed on energy efficiency was born from the Board's recognition that energy savings convert directly into profit, which is ongoing year after year.

In 1986, Cedric Rodrigues was appointed Group Energy Adviser. Over the last six years his unique approach to Energy Management has reduced energy costs by an estimated £8 to £10 million/year whilst during this period Group sales increased by 80%. His success throughout the Group has resulted in GEC factories winning numerous national and regional energy awards. The commitment of the GEC Board of Directors to energy efficiency, demonstrated by appointing a Group Energy Manager reporting at Board level, has been instrumental in securing the commitment of senior management and realising the savings potential throughout the GEC Group.

5.2 Approach to Energy Management

The 1973 oil crisis prompted GEC to appoint a Group Energy Coordinator who was responsible for auditing factory energy use and suggesting energy efficiency recommendations to factory management. In 1986, with the appointment of Cedric Rodrigues this role changed from purely auditing to a closer advisory role. Following his audits he prioritised energy efficiency recommendations into an action plan and supported this with ongoing advice to site management to assist implementation.

5.3 Management Structure

GEC operate a decentralised management style and so responsibility for energy management lies with the individual sites. However, Cedric Rodrigues has the authority from the Board to audit sites as and when he feels necessary. On his advice, each site having an energy bill in excess of £1 million appointed a full time Energy Manager, whilst sites having an energy

bill in excess of £500,000 appointed a full time Energy Engineer. The numerous smaller sites were advised to appoint a part time Energy Engineer.

Fig 7 GEC Alsthom - manufacture of high-voltage switchgear

5.4 Energy Audits

Cedric Rodrigues has undertaken energy audits of all 150 GEC sites. He views the auditing process as ongoing, and follows a three-to-four year cycle.

The execution of audits across such a major Group is only possible because of Cedric's unique approach. In order to minimise the amount of his time spent on audits he forwards pro-formas on which the site Energy Manager or Energy Engineer is instructed to provide details concerning the site's energy usage and energy consuming plant.

Once this basic data collection is undertaken by the site staff, maximum use can be made of the audit time in analysing energy consumption and producing recommendations.

A key element to this approach is that site staff are involved in collecting and assisting in the data analyses and therefore have a better understanding and ownership of the recommendations, leading to a personal commitment to energy efficiency.

5.5 Total Energy Monitoring

The audit undertaken by Cedric Rodrigues centres around a model for total energy consumption based on data from a reference year typical of the site's activity. This incorporates variable coefficients for the space heating load, lighting load and production throughput, and a general factory-fixed load. This model is then used to calculate target energy consumption in relation to production and degree days. The target consumption is compared with the actual consumption month by month to monitor performance.

Subsequent to the factory audit, in order to provide control, the reporting of actual energy consumed against target consumption becomes a regular feature of each site's monthly management accounts, and this data is scrutinised by Cedric Rodrigues. This provides a strong motivational factor with local management striving to equal or better their target.

5.6 Flow of Information

Cedric Rodrigues is also able to play a central role in dissemination of information and this he views as being invaluable, preventing the "re-invention of the wheel". Successful projects are replicated across the Group and experience gained in the application of energy efficient technology is made available to Group factories for similar projects. Energy bulletins have also been produced to publicise successes in energy saving and distributed to all factories.

5.7 Motivation and Awareness

In the early days, energy consumption labels were installed on major items of plant, reminding staff of the hourly cost of operating the plant as well as a general sticker and poster campaign.

In recent years, the emphasis of the campaign has switched to energy efficient technology, although work has been undertaken to encourage staff awareness. In the words of Cedric Rodrigues "Energy waste is a bit like sin, in that everyone claims to be against it, but unaccountably there will always be a lot of it about."

Cedric Rodrigues recognises that staff participation and motivation towards energy efficiency would not be achieved without ownership of the issue, and this was addressed by establishing the accountability of the senior management at each site for achieving energy performance targets. These methods backed by the Board of Directors provided a necessary and effective motivational factor.

5.8 Summary

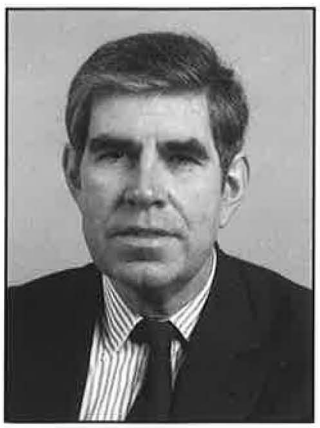
The GEC Board of Directors recognise the potential for saving through energy management and the need for commitment at the highest level. The appointment of Cedric Rodrigues at Group level, reporting directly to the Board, has had a profound effect on energy efficiency throughout the GEC Group.

Cedric's unique approach to energy management has centred around developing ownership for the energy efficiency issue at site level, actively involving staff in creating their own energy strategies and being available for support and assistance at all times.

Since his appointment in 1986, Cedric Rodrigues has achieved savings estimated of between £8 - £10 million/year, which when considered in profit terms by GEC, are equivalent to securing £80 to £100 million worth of sales/year, without any costs of securing the sales. This in any terms is quite phenomenal, yet it has been realised through the effective application of simple management techniques to energy efficiency.

6. CASE HISTORY 4 - CHRISTOPHER JOHNSON - WEDGWOOD GROUP

PART OF WATERFORD WEDGWOOD



CAREER HISTORY

In 1987, having held a number of Senior Management positions within the Group, Christopher Johnson was appointed Assistant Managing Director and subsequently became Vice Chairman and Chief Executive, Manufacturing of the Wedgwood Group. He is currently Production Director of the Wedgwood Group and a Main Board Director of Waterford Wedgwood plc.

"I REGARD ENERGY AS A VITAL AND INCREASINGLY IMPORTANT ELEMENT IN OUR COST STRUCTURE, AND ACCORDINGLY WE ARE OPERATING SYSTEMS TO MONITOR AND CONTAIN CONSUMPTION TO A MINIMUM"

6.1 Introduction

Christopher Johnson is a Main Board director of Waterford Wedgwood plc., and is also Production Director of the Wedgwood Group. The Wedgwood Group employs approximately 5,000 staff over nine sites. The Group has an annual energy bill of £5.5 million which currently represents 2.1% of turnover. The Group manufactures earthenware and china for the UK and overseas markets.

Christopher Johnson initiated the setting up of a formal energy management programme in 1987. He also encouraged participation in the Energy Efficiency Office's Demonstration Schemes, which helped the Group to incorporate the latest technology into many of its energy intensive processes.

It is conservatively estimated that since 1987, the energy management programme and improvements in process efficiency have resulted in cost savings worth in excess of £1 million.

6.2 Motivation Towards Energy Efficiency

Christopher Johnson initially became involved in energy conservation during the 1973 oil crisis. The success of measures taken during this period demonstrated energy to be a controllable cost, worthy of attention.

In recent years the privatisation of the gas and electricity industries provided a further incentive. In his view, companies such as Wedgwood which already managed energy and had a good appreciation of usage patterns, were in a better position to negotiate energy purchases with alternative suppliers.

Fig 8 Potters wheel in operation

6.3 Monitoring and Targeting (M&T)

Utility meter readings had been taken at most sites for some years. However, in 1987 as a result of meetings with British Ceramic Research Limited (BCRL), who were developing and promoting the use of M&T in the Ceramics Industry, Christopher Johnson decided to take a more formal approach to Energy Management.

He gave the electrical engineer at Wedgwood's Barlaston site responsibility for energy management. The Energy Manager started by setting up an M&T system, using his own spreadsheet-based software to record weekly energy data from all sites. At this time little investment was available for M&T in terms of finance and manpower. Consequently the M&T system initially concentrated on the main energy users and was expanded slowly with gradual investment in sub-metering.

Under the M&T system the performance of several similar items of plant such as dryers were compared. Investigation into reasons for variations in performance was followed by remedial action such as burner tuning and improved insulation of the poorer performers, producing savings of 5 to 10% in most cases.

Initially problems were encountered in identifying the weight of product passing through specific items of plant, which in turn presented difficulties in relating energy consumption to production throughput. This arose from weekly variations in product mix and in the number of firings required by particular product types, and consequently production volumes could only be derived from best estimates.

The M&T system has since been refined and its development is continuing. t one site mathematical equations have been developed to predict the total site energy consumption. At others, manufacturing earthenware, the value of product passing through the site has been established as a measure of production output and this shows good correlation with energy consumption. In 1990, the M&T system was enhanced by the use of pulsed meters to supply energy data directly into the M&T software.

6.4 Management Structure and Flow of Information

Fig 9 shows the management structure in place at the Wedgwood Group. Much of the success at Wedgwood was due to the dedicated efforts of the team responsible for Energy Management, the regular, bi-monthly meetings between Christopher Johnson, the Energy Manager and Group Engineer to review the performance of all sites and progress achieved.

A directive was also issued for a meeting to be held every six weeks between the Production Director of each site and the Energy Manager. At the meetings the site's weekly energy performance was reviewed against production and any required actions identified. Through these meetings the Energy Manager was able to ensure the sharing of ideas between all sites and the importance of making decisions at the meetings and ensuring they were acted upon was stressed.

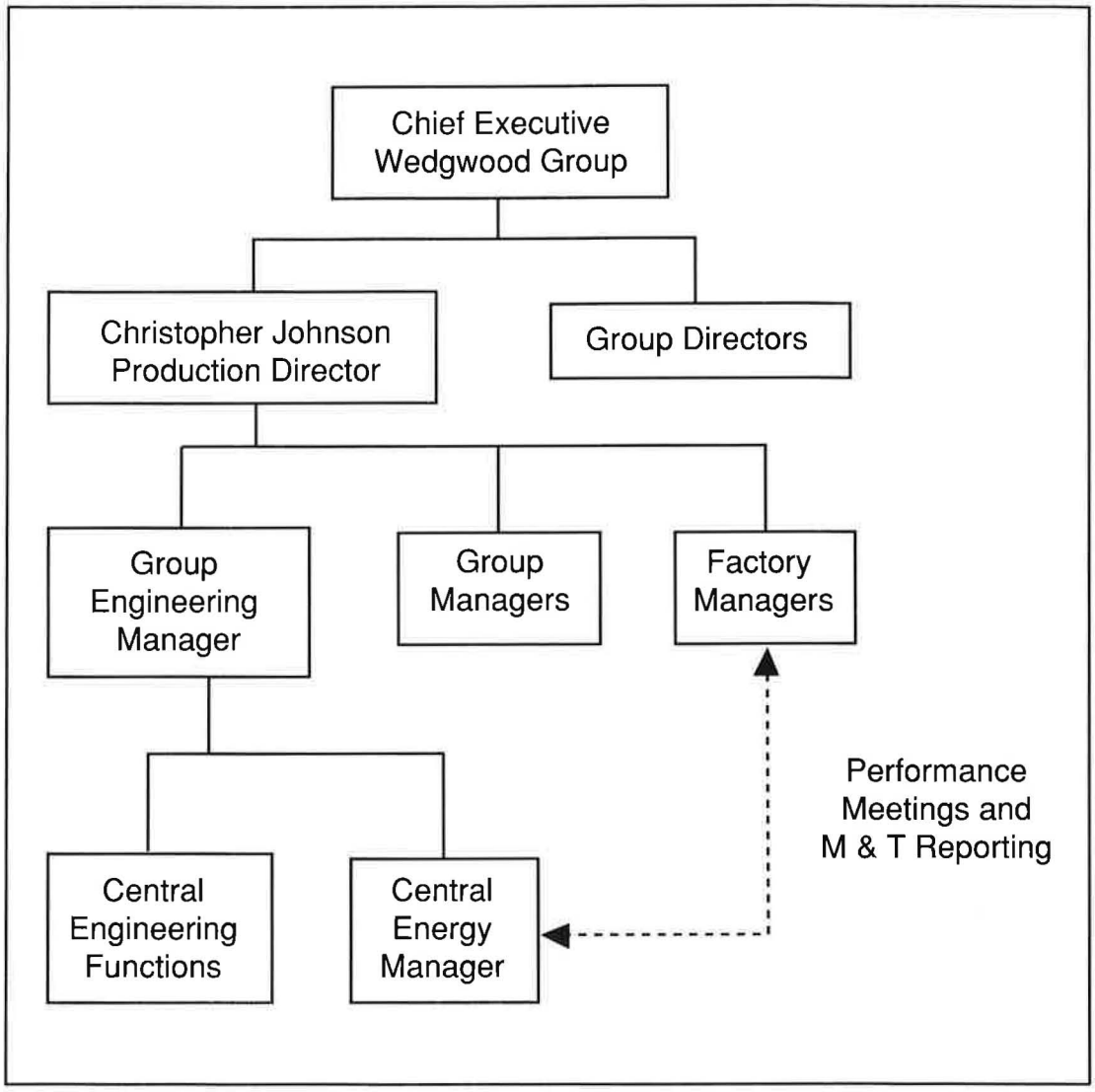


Fig 9 Management structure

6.5 Fuel Purchasing

Christopher Johnson felt that it was important for his staff responsible for managing energy to also be responsible for its purchase, as this gave ownership of the entire energy scenario and served to increase their commitment. He and his staff were quick to realise the potential benefits of purchasing gas and electricity from alternative suppliers and in 1991 this resulted in cost savings in the order of £400,000.

6.6 Manufacturing Plant

The efficient use of energy in the manufacturing process was considered to be a matter of extreme importance. To this end the Company participated with the Energy Technology

Support Unit (ETSU) and BCRL in hosting several demonstration projects on the use of fast-firing kilns, heat recovery and low thermal mass refractories.

The work with ETSU and BCRL proved to be invaluable. During a period of expansion the use of fast-firing kilns enabled the company to double production in many areas, whilst maintaining energy consumption at a similar level.

The importance of plant maintenance was also recognised and all gas-fired plant received planned maintenance. In the case of kilns, safety was the primary reason for maintenance, but the burner tuning, replacement of insulation and door seals also had an impact on energy consumption.

Fig 10 Continuous tunnel kiln

6.7 Barriers to Energy Efficiency

Whilst the implementation of Just In Time (JIT) and TQM have been of significant benefit to the Group's operation, it was found that such disciplines could conflict with energy efficiency.

Under JIT it was found that the production time scales and product mix dictated by customer demand could lead to inefficient loading of kilns. In addition, for certain products heat recovery systems on kilns had to be switched off in order to achieve the required standards of product quality. The M&T system operated throughout the group was of great value in addressing these problems. It provided good visibility of the implications on energy consumption and allowed the delicate balance between product quality, customer demand and energy efficiency to be achieved.

6.8 Finance

Since the appointment of an Energy Manager, many simple low cost schemes have been implemented. The criteria of these schemes being that they had to be low cost, and pay back the capital invested within the same financial year.

Where significant investment was required the assistance of a Contract Energy Management (CEM) Company was used. At the Group's Hotelware factory the improvements provided by the CEM Company included the installation of heat recovery and computerised energy management systems, resulting in savings in the gas and electricity consumption of 10% and 5% respectively. Further potential savings were limited because of product quality considerations.

6.9 Summary

In spite of having limited finance available for investment in energy saving schemes Christopher Johnson's commitment to energy efficiency has achieved a great deal. He has ensured regular meetings between the senior management of all Wedgwood sites and his Energy Manager, and ensured that where possible action has been taken.

Through participation in EEO Demonstration Projects, and liaison with BCRL, energy efficient technology has been incorporated in process improvements. This, combined with careful management and purchasing of energy, and implementation of simple measures, paying back in less then twelve months, has resulted in substantial ongoing savings. Where benefits required major capital investment then CEM has been used to progress the work.

7. CASE HISTORY 5 - JOHN PILLING - BRINTONS LIMITED

CAREER HISTORY

John Pilling joined Brintons as an apprentice and received training in Mechanical and Textile Engineering. He spent some time in the Design and Development Section before proceeding into general engineering management. In 1983, he was appointed Divisional Engineering Manager and became a Main Board Director in 1988. He is a Chartered Engineer and a member of the Institute of Mechanical Engineers.

"A 10% SAVING IN THE ENERGY BILL IS VERY WORTHWHILE. IT REFLECTS DIRECTLY ON MY BOTTOM LINE PROFIT"

7.1 Introduction

John Pilling currently holds the position of Engineering Director and is responsible for the three Brintons manufacturing sites. Brintons Limited manufacture high quality carpet for the UK and export markets and employ approximately 1,800 staff. The Company has an annual energy bill of £2 million representing approximately 2.7% of current turnover.

John Pilling has been instrumental in achieving major energy savings through a number of initiatives including improvements to the production processes, and relocation to modern energy efficient factories during rationalisation. In addition to this, annual savings approaching £180,000 resulting from low cost and improved housekeeping measures have been gained over the last three years, in spite of increasing levels of automation within the Company.

In 1987, the Company received a British Gas GEM Award for replacing a steam heated latexing process with a direct fired system.

7.2 Motivation towards Energy Efficiency

It was the oil crisis of 1973 which focused John Pilling's attention on energy saving. Measures taken at that time out of necessity made him realise how easy it was to save energy. This, together with his philosophy of always striving to identify opportunities for improvement in all aspects of the business, resulted in his present commitment to energy efficiency.

7.3 Approach to Energy Management

John Pilling's approach to energy management has been based on a two pronged attack. The first route has been to concentrate on the major opportunities, e.g. using the most efficient source of energy for each process application, ensuring that tariffs are negotiated to the lowest possible level and ensuring that energy as an ongoing operating cost is considered during every major investment.

In recent years Brintons have pursued a policy of not investing large amounts of capital in old factories with inherent inefficiencies. Instead they have invested in new, efficient factories and moved production to these sites. This is demonstrated in the Telford and

Stourport Road sites which have good levels of natural light, require little space heating and incorporate the latest energy efficient process equipment.

Fig 11 Modern energy efficient building

The second area of attack has been to secure savings through good housekeeping and low cost measures at all sites irrespective of age. With this is mind, John Pilling appointed an Energy Efficiency Officer in 1988, whose brief was to achieve savings through increased employee awareness and motivation towards energy efficiency and by identifying "no cost" and "low cost" energy saving schemes.

7.4 Appointment of an Energy Officer

John Pilling chose to appoint an Energy Officer internally, as he recognised the value of using someone with an intimate knowledge of the three sites. The Energy Officer therefore required training in energy management procedures which was achieved through the EEO seminars, and free advice from the Regional Energy Efficiency Officer.

7.5 Motivation and Awareness

The task of increasing employee awareness was initially tackled by poster campaigns using free posters from the EEO. This progressed to the distribution of customised leaflets on energy saving in the home to all employees. Further leaflets in humorous cartoon format related the company's energy bill to the domestic situation, For example, identifying the length of time that a two-bar electric fire would operate in order to match the Company's electricity bill, and the number of baths that the Company's gas consumption could produce.

To encourage involvement, a competition for employees' children on the design of a poster to increase energy awareness was also launched, the winner receiving a £50 voucher at a presentation evening in the company social club. The voucher was presented by the West Midlands Regional Energy Efficiency Officer.

Slips of paper were also passed on to all employees in their pay packets, reminding them of cash prizes in the Company suggestion scheme, and requesting energy saving ideas. To impress upon staff the high priority that he gave to energy efficiency, John Pilling felt that

it was important for his Energy Officer to be regularly seen at each site. To this end he was instructed to visit each site personally to take the weekly meter readings.

7.6 Avoiding Waste

An important step in reducing energy wastage through improved housekeeping was the allocation of responsibility for energy in each area of the sites to supervisors. Subsequently security staff at each site were instructed to record all items of equipment and lighting that were left on each evening, and their location. To this information the Energy Officer added the name of the supervisor responsible for the area in question, prior to feeding it back to the site management and supervisors.

This action resulted in a considerable decrease in energy wastage at all sites, as can be seen from Fig 12 which shows the number of incidents of equipment left on each month over a six month period.

An important feature, demonstrated in Fig 12, is the higher level of wastage which occurred at the oldest site (Exchange Street). This was attributed to the ingrained attitudes and culture of staff at the older, less efficient site. In spite of this, a 78% reduction in the level of wastage was still achieved at this site.

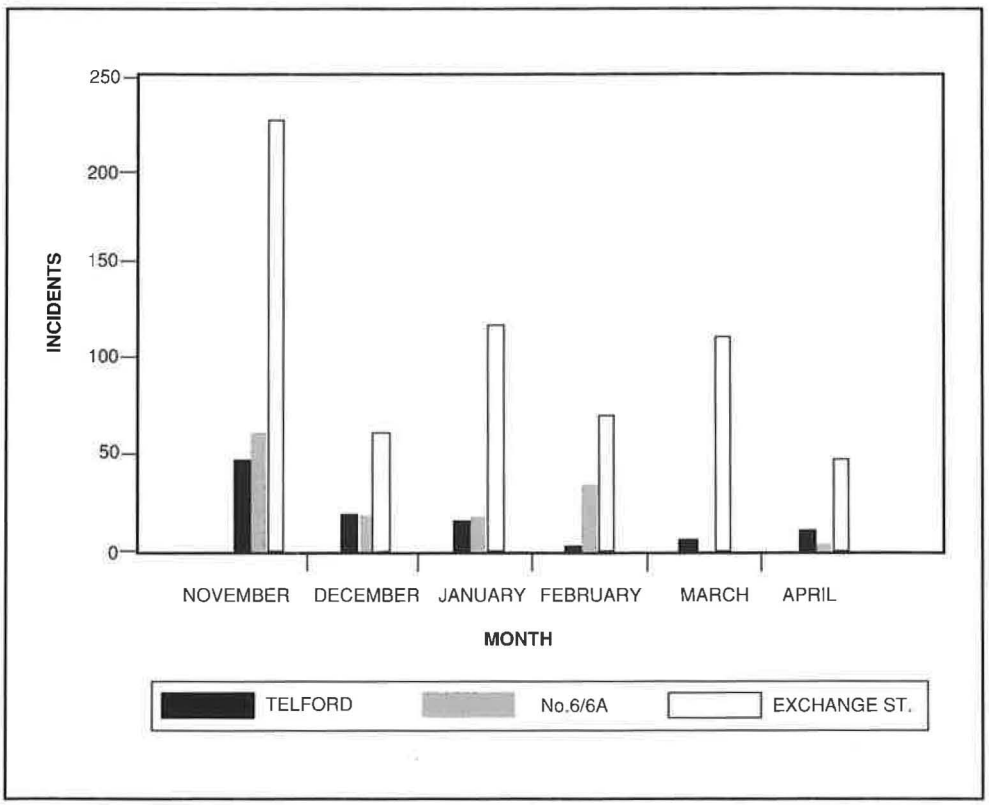


Fig 12 Reduction in wastage

7.7 Monitoring and Targeting (M&T)

Shortly after his appointment, the Energy Officer commenced weekly monitoring of energy consumption and used his own spreadsheet-based M&T system to reduce the amount of time spent on data analysis for the 26 cost centres over the three sites.

Initial targets from the M&T for improved performance were set at 5% below budget, and savings realised in the majority of cost centres substantially exceeded this expectation.

The energy consumption per square meter of carpet produced was examined each week by the Energy Officer and compared with previous performance and action was taken to rectify increases in consumption. A typical example being the identification of an air compressor operating unnecessarily.

Internal temperatures at each site were continuously monitored by the use of thermographs. From this, the Energy Officer was able to ensure that temperatures were closely controlled.

7.8 Management Structure and Reporting Procedures

The M&T system generated monthly reports showing the energy consumption and cost per metre of carpet produced at each cost centre. Staff received these reports at all levels including John Pilling, senior and middle management in the production and engineering departments and staff responsible for each cost centre. The management structure in place at Brintons is shown in Fig 13.

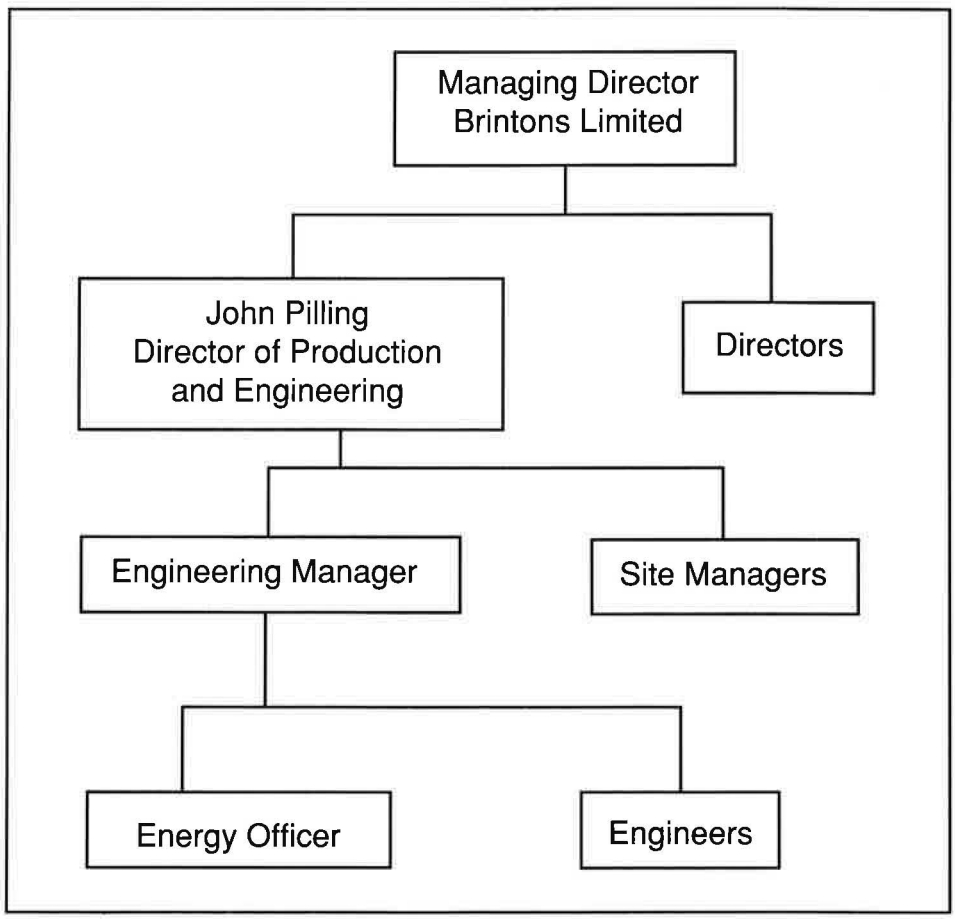


Fig 13 Management structure

7.9 Manufacturing Plant

It is the Company's policy to always look to design improvements to machinery whether from a replacement point of view or as a result of maintenance or breakdown. Brintons have a world renowned reputation for designing and developing their own carpet making looms which now incorporate the latest technology and have been constructed with energy efficiency as an important factor.

John Pilling was also keen to ensure that energy was considered during the design of new factories, high levels of insulation and natural light being particularly important. Concern for future running costs also prompted the use of high frequency lighting instead of conventional fluorescent lighting.

7.10 Summary

John Pilling recognises that cost savings achieved through improvements in energy efficiency are turned directly into profit. His policy has been to incorporate the latest energy saving techniques whenever capital investment is necessary and this has been predominantly in the construction of purpose-built factories and modifications to production processes. This has been a major financial benefit to the Company, although it is difficult to identify the exact value of savings whilst the Company's operation has undergone such significant change, and the level of process automation has increased.

However, his simple approach of improving energy awareness, gaining cooperation of employees and implementing low cost measures at existing sites has resulted in savings approaching £180,000 over the last three years, in an environment that has become increasingly automated.

8. CASE HISTORY 6 - PETER HAYTHORNTHWAITE - FISONS SCIENTIFIC EQUIPMENT - PART OF FISONS PLC

CAREER HISTORY

In 1975 Peter Haythornthwaite joined the Fisons plc Headquarters as a specialist in Operational Research. In 1981, he moved to Fisons Scientific Equipment as Planning and Administration Manager. In 1990, he became the Quality and Administration Manager, responsible for coordinating the Total Quality Management programme and reporting directly to the Managing Director.

"IT IS OUR RESPONSIBILITY TO SATISFY THE REQUIREMENTS OF OUR CUSTOMERS, AND ALSO SATISFY THE REQUIREMENTS OF THE ENVIRONMENT."

8.1 Introduction

Fisons Scientific Equipment is a part of Fisons plc. The achievement of Peter Haythornthwaite set out in this case history refers to his work at Fisons Scientific Equipment. The Company manufactures and packs laboratory equipment and specialist chemicals, employs approximately 600 staff and has an energy bill approaching £300,000/year representing less than 1% of turnover.

The approach to energy cost reduction has concentrated on securing the support and participation of all staff in identifying opportunities for saving and improved housekeeping measures. This was carried out as part of the Company's Total Quality Management Programme and it is estimated that savings in the order of £50,000/year have been realised.

Peter Haythornthwaite is quick to point out that the achievements are not entirely personal ones but have resulted from team work and enthusiastic support from colleagues.

8.2 Motivation Towards Energy Efficiency

Peter Haythornthwaite's commitment to energy efficiency came from the realisation that energy represented a controllable cost which should be addressed as part of any programme of improvement within the Company. This was reinforced by the Group Environmental Policy set out by Fisons plc. Peter Haythornthwaite subsequently produced a further statement of environmental policy for Fisons Scientific Equipment, which established a commitment to avoid the wasteful use of non-renewable resources including energy.

8.3 Approach to Energy Management

Energy Management commenced in 1988 with the start of formal energy monitoring, whilst several schemes to reduce energy consumption were implemented. In 1990 all employees became involved in the Company's Total Quality Management (TQM) Programme, and since then Energy Management has been driven by the TQM Programme.

8.4 Management Structure

Fig 14 shows the management structure in place at Fisons Scientific Equipment, with Peter Haythornthwaite reporting directly to the Managing Director. The Site Service Manager, John Barker assisted by his Projects Engineer report on energy to Peter Haythornthwaite.

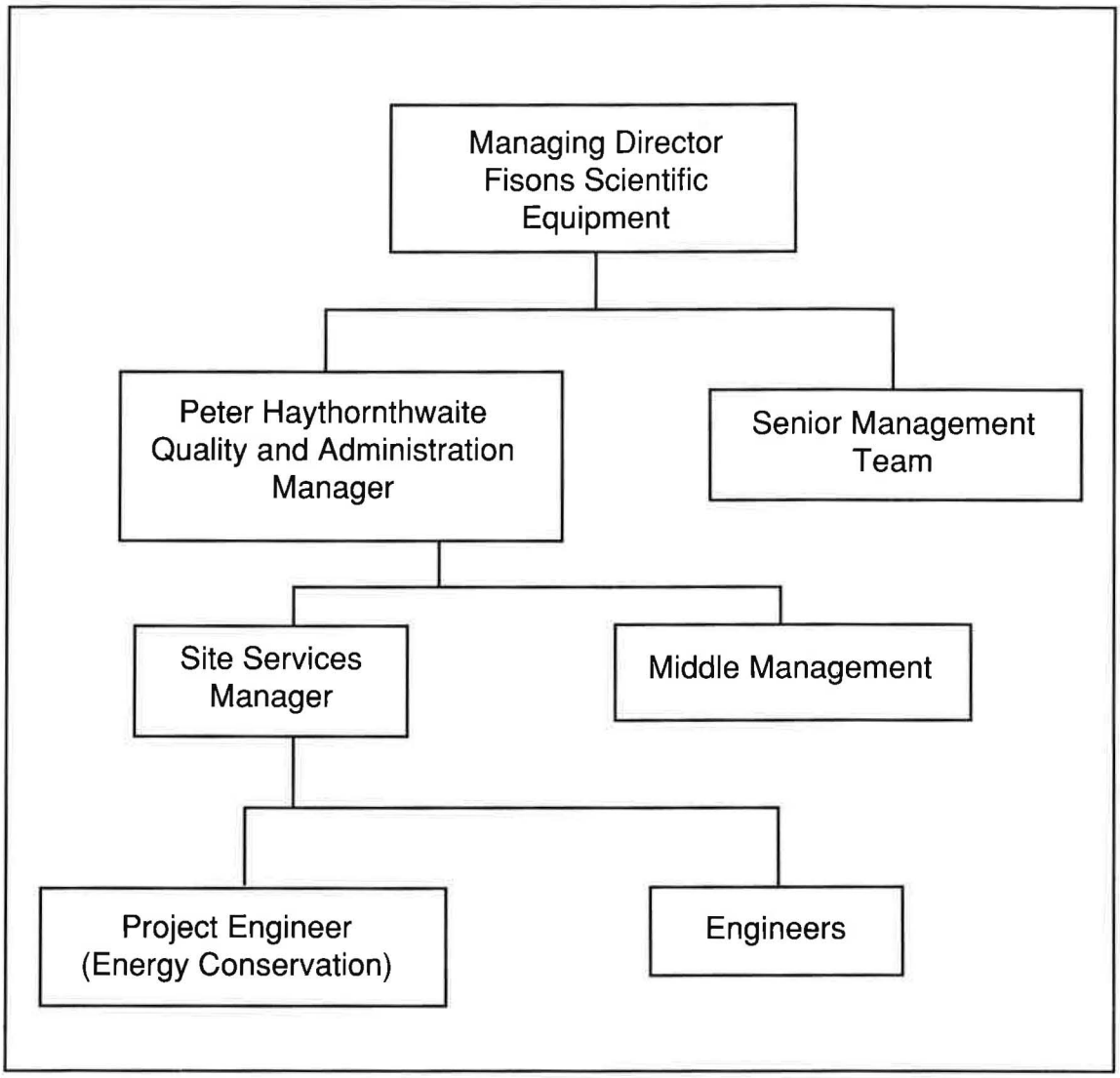


Fig 14 Management structure

8.5 Total Quality Management (TQM)

In 1990, the Managing Director introduced a Total Quality Management Programme, coordinated by Peter Haythornthwaite, called Quality Plus. The aim of Quality Plus was to eliminate waste and errors in all aspects of the business, whilst satisfying the requirements of the customer and the requirements of the environment. A Quality Team chaired by the site services manager was set up to generate ideas for ways in which energy could be saved. The team met monthly and comprised of six staff, with other staff being co-opted on to the team as and when beneficial.

8.6 Awareness and Motivation

As part of the Quality Plus Programme several "Quality Notice Boards" were installed in prominent locations throughout the site, and these were used to publicise quality related activities. The Energy Efficiency Display presented details of the site's energy consumption, including the daily cost of providing lighting and operating particular items of plant. This served to increase awareness and realisation of the extent of energy costs.

8.7 Declaration of Commitment

The display included leaflets which employees could complete declaring a commitment to energy efficiency. The leaflet stated "I have got the energy bug" followed by the employee's signature. On returning the leaflets each employee was sent a small furry "Energy Bug", which they could stick by light switches and on VDU screens. This generated a great deal of interest and the Energy Bug served as a useful reminder to switch off equipment and lighting.

8.8 Staff Suggestion Scheme

Under the Quality Plus process a staff suggestion scheme was introduced, requesting ideas for improvements in all areas of the site including energy efficiency.

To encourage response a monthly draw was held and three entries drawn out of a hat received prizes. n addition to this, there was a recognition system which donated prizes for the best suggestions and the highest number of suggestions entered by an individual. This was exceptionally successful with up to 50 suggestions/year received from some employees.

Separate prizes were donated for suggestions concerning improved energy efficiency and over a two month period 30 to 40 energy related suggestions were received.

Fig 15 Fisons distribution operation

8.9 Publicity

The Quality Plus process recognises the value of publicising success stories and quality charts including graphical representation of savings achieved were displayed on notice boards.

A good example of this was the implementation of two suggestions concerning the recycling of hot water and installation of automatic isolation valves on the bottle washing plant, which together saved approximately £20,000/year.

Another successful suggestion was the use of separate bins to aid waste paper collection in each office. The waste paper could then be shredded and used for packing materials. This reduced the requirement to purchase packing materials and indirectly saved energy and environmental resource in the production of packing materials.

8.10 Energy Monitoring

In 1988, an energy monitoring system was installed and Consultants were employed to remotely monitor the energy consumption of four cost centres within the process area through the pulsed output of sub-meters. The Consultants analysed the data and returned it to site each week enabling each cost centre to be charged for energy, thereby establishing ownership of energy usage and providing motivation towards energy efficiency. Consideration is now being given to extending the system to cover the office and warehouse areas.

8.11 Maintenance Management

Towards the end of 1989 a computerised preventative maintenance system was installed, which greatly reduced the number of plant breakdowns. Whilst difficult to quantify, it is considered that this also contributed to energy savings as it reduced wastage due to machinery operating inefficiency prior to failure.

8.12 Life Cycle Costing

The Company has increasingly tried to ensure that operating costs were always considered when new plant was purchased. When the heating boiler serving one of the office areas was replaced, a condensing boiler was specified and during the refurbishment of fluorescent lighting the opportunity was taken to specify high frequency fittings. These measures achieved energy savings of 10% and 22% of the respective service costs.

Fig 16 Fisons warehouse

8.13 Barriers to Energy Efficiency

In the case of Fisons Scientific Equipment, Peter Haythornthwaite feels that there have been two main constraints to energy efficiency.

- the legacy of decisions made in the past such as construction of inefficient buildings, heating systems and installation of inefficient plant;
- the culture of British people who appear reluctant to pay a premium for higher levels of energy efficiency in the home, or take the trouble to save energy by switching

off lights or appliances. If people use energy inefficiently at home, it is more difficult to encourage efficiency in the work place.

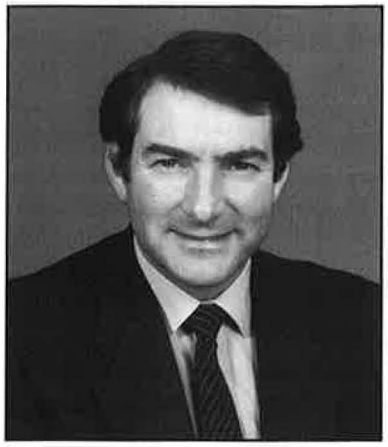
The Quality Plus Programme has addressed the latter with some success, but he feels it is a process which must be ongoing.

8.14 Summary

At Fisons Scientific Equipment, Energy Management has become an integral part of the Company's Environmental Policy. An important feature of Peter Haythornthwaite's approach to Energy Management has been his success in involving staff in reducing energy consumption. This was largely achieved by a novel and effective suggestion scheme and by encouraging staff to sign a declaration of commitment to energy efficiency. In this manner he has achieved staff interest, suggestions and commitment to energy efficiency at all levels throughout the organisation, and this has been the key to a quality improvement process which has shown some encouraging successes.

He also considers that establishing ownership for the energy consumed by each department and considering life cycle costs when purchasing new plant, is important as is the Company's commitment to implement many of the suggestions received.

9. CASE HISTORY 7 - PETER F. CRAWFORD - AUTOMOTIVE PRODUCTS



CAREER HISTORY

Peter Crawford is Chief Executive of the Automotive Components Division of the BBA Group plc. He joined Automotive Products plc as an apprentice, has held the positions of Group Engineering Director, Director of UK Operations, and Managing Director. He was appointed to the Executive Board of BBA shortly after its acquisition of Automotive Products in 1986. He is a Chartered Engineer, a Member of the Institution of Mechanical Engineers and a Fellow of the British Institute of Management.

"ENERGY EFFICIENCY TOUCHES ON ALL ASPECTS OF THE BUSINESS FROM PROCESS CONTROL, THROUGH PRODUCT QUALITY TO ENVIRONMENTAL SAFETY AND COMFORT. IT IS THEREFORE A FUNDAMENTAL ASPECT OF BUSINESS LIFE WHICH CANNOT BE IGNORED".

9.1 Introduction

Peter Crawford currently holds the position of Chief Executive of Automotive Products (AP). The Company employs some 4,000 staff, has a turnover approaching £300 million and an energy bill for gas and electricity for the Leamington site of £2.2 million.

In 1985, Peter Crawford and his Board took the decision to embark on a Contract Energy Management agreement under which new energy efficient plant was installed at no cost to AP. The energy management package provided under the agreement and other initiatives by AP staff have achieved savings currently worth approximately £800,000/year against their total energy bill.

To emphasise the priority that he places on energy efficiency Peter Crawford signed the Department of the Environment's Corporate Commitment Campaign in 1992.

9.2 Background

In 1984, the Company was contacted by a firm of Energy Consultants, who offered to carry out a short energy survey on gas usage free of charge. The offer was accepted and the potential level of savings identified led to the Consultants being commissioned to carry out an extended survey to accurately quantify the savings and investment required.

The survey identified savings of approximately £500,000/year with considerable peripheral savings, and its recommendations were presented to the Board. The Board agreed with the financial conclusions and notably the value of the savings, but at the time the Company was concentrating its capital resources on renewing its manufacturing plant and equipment. Peter Crawford therefore sought the assistance of a Contract Energy Management Company, who provided the majority of the required £1.9 million capital investment.

Fig 17 Automotive Products site

9.3 Contract Energy Management (CEM)

Under the CEM arrangement the installation of the new plant was carried out at no cost to AP, who received 80% of the savings achieved below a set target. The CEM company also provided a full energy management package including Monitoring and Targeting (M&T) and Staff Training.

The majority of the savings were achieved through decentralisation of the site's steam system and installation of gas fired process and space heating. The assistance of the CEM company was used in selecting the most efficient and most appropriate form of heating for each process. This involved a close liaison with AP engineers to ensure that the process and product quality requirements could be satisfied. In every instance full agreement between the CEM company and AP was reached prior to implementation.

During the installation of the new gas distribution pipework the opportunity was taken to install submeters to facilitate separate monitoring of the energy used for process and environmental heating in each area of the site. Data from the submeters was used by the CEM Company's resident Energy Manager in providing a monitoring and targeting facility for the site.

From the outset, the CEM company and AP engineers paid close attention to comfort conditions to ensure acceptance by employees whose local control of environmental heating had been replaced by the computerised system.

9.4 Reporting Procedures

Monthly energy reports were generated from the M&T system and passed to AP's Facilities Manager, who had responsibility for energy. The reports included reasons for variations in consumption and suggestions for further energy saving measures. This data was also summarised in quarterly reports presented to Peter Crawford, his Financial Director and the Works Engineer.

9.5 Staff Training

Engineers from the CEM company working alongside AP staff provided on-the-job training in operating the new energy efficient plant, and in the principles of energy management, including the operation of M&T systems. This enabled all staff to assist in the cost reduction programme, and increased awareness of further energy saving opportunities. It is estimated that this was responsible for up to 15% of the total savings.

Peter Crawford also recognised the importance of regularly updating key staff on developments in technology and energy management techniques, and to this end engineering and maintenance staff regularly attended external seminars and exhibitions organised by bodies such as the Energy Efficiency Office and the Energy Systems Trade Association (ESTA).

9.6 Awareness and Motivation

In addition, Peter Crawford took steps to ensure that the Company's good housekeeping practices were adapted to optimise the benefits of the scheme, and that energy and water consumption were minimised.

He recognised that in order to achieve these potential savings it was essential to establish ownership of energy consumption, and to this end submeter readings were used to charge departments for their energy. This prompted Departmental Heads to operate their own "Save It" campaigns.

A Load Management Campaign was also introduced, under which each department was instructed to switch off all unnecessary items of electrical plant at particular times of the day, when peaks in maximum demand were likely to occur. This was primarily done to reduce maximum demand charges but also served to reduce electricity consumption.

The improved level of awareness led to AP engineers installing additional simple energy saving devices such as thermostats and time switches.

9.7 Manufacturing Plant

An element of the Total Quality Management and Just in Time systems in force throughout the Company was the organisation of production into small self-contained cells. Whilst this was not primarily undertaken for energy conservation it considerably reduced energy consumption.

Peter Crawford also intensified a policy of specifying energy efficient equipment when buying new plant, and took advice from the CEM company on the energy implications when specifying new plant or during departmental reorganisations.

9.8 Summary

The decision taken to finance major energy saving schemes under a Contract Energy Management agreement has made a valuable contribution to AP's efficiency. The comprehensive Energy Management package provided under the agreement has resulted in savings in excess of £800,000/year.

A close liaison between the site staff and CEM staff was the key element to the success of this campaign combining local knowledge with the experience of the energy specialists. Savings continue to grow through advice provided by the CEM company when purchasing new plant and through AP's own awareness campaigns.

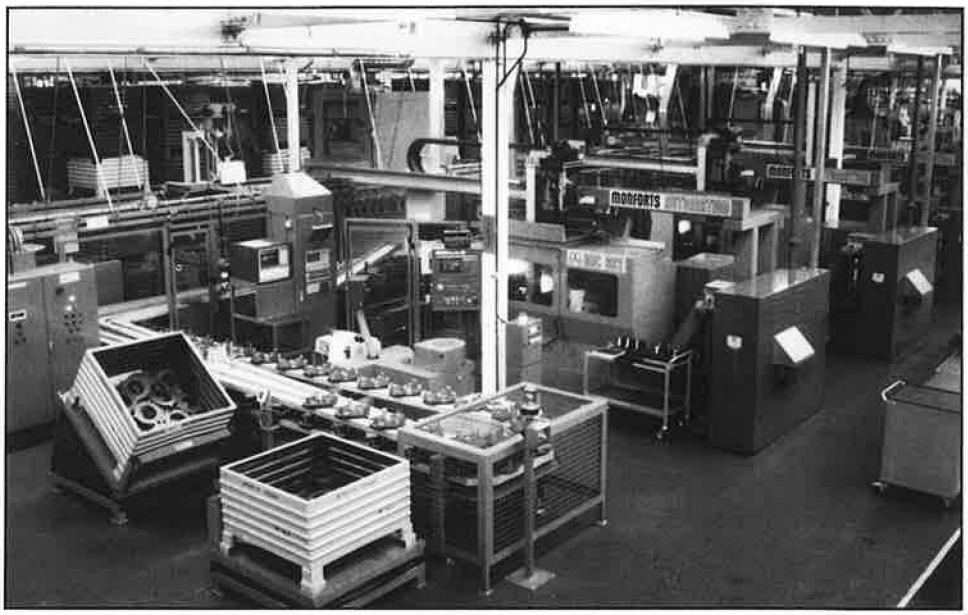


Fig 18 Pressure plate manufacturing cell

10. CASE HISTORY 8 - DAVID HOLDSWORTH - J. HOLDSWORTH & CO LTD

CAREER HISTORY

David Holdsworth joined the family business in 1975 after graduating in Physics and Textile Technology. In 1978, after holding supervisory positions he was appointed Works Engineer. In 1983, after progressing through various management positions he was appointed Production Director.

"QUALITY MANAGEMENT INCLUDES ENERGY EFFICIENCY"

10.1 Introduction

J. Holdsworth and Company, employ 240 staff and manufacture fabrics for the transport industry. The Company has an energy bill of £110,000 representing approximately 1% of turnover.

David Holdsworth has taken a strong personal interest in energy management since 1978. Energy management has become something of an interest for him and he has gained personal satisfaction from saving energy and reducing carbon dioxide emissions.

His single handed commitment to energy efficiency has resulted in the site's total energy bill per metre of fabric produced being reduced from 23p per metre in 1978 to 9p per metre in 1991 and this represents a saving in excess of £100,000/year.

It is not common to find such attention paid to energy management in companies that are of low energy intensity or of this size, but the savings achieved clearly justify the effort invested.

10.2 Motivation Towards Energy Efficiency

In 1978, David Holdsworth temporarily took on the position of Works Engineer and was able to identify areas of significant waste. For example, in one particular area of the site large quantities of steam were being wasted from an open tank. He quickly realised how costly this was and corrected the situation.

10.3 Use of External Advice

Initially David Holdsworth adopted a piecemeal approach to improving energy efficiency, rectifying particular areas of waste that he had identified. On realising that steam generation accounted for the majority of the site's energy consumption, he decided to seek external advice and brought in a manufacturer of steam controls to carry out a survey of the steam system. As a result of this many low cost and housekeeping measures were implemented, including replacement of steam traps, insulation, zoning and provision of condensate return. This achieved an immediate 40% saving in the cost of steam generation.

In spite of this success, he recognised that there were still further opportunities and consequently in 1982 he commissioned Consultants to carry out a full energy audit of the site.

The audit identified many more "no cost, low cost" and "medium cost" energy saving opportunities for all fuels, and subsequently the majority of these measures were implemented.

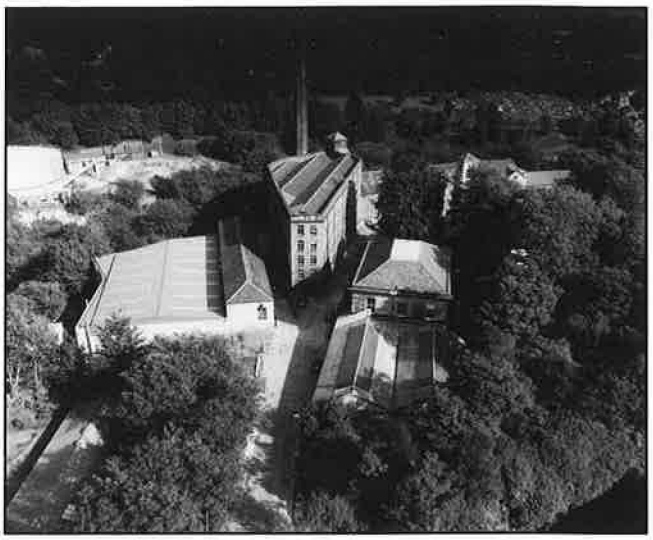


Fig 19 The Holdsworth site

10.4 Manufacturing

David Holdsworth recognised the value of listening to the views of all staff and discussing and progressing the merits of their suggestions. It was this, together with David's own critical examination of energy used in the manufacturing process, that formed the key element in his campaign. Prime examples are changes to the method of heat generation for the finishing and latexing processes, which resulted in a fourfold increase in production throughput for a negligible increase in energy consumption.

The energy implications of plant maintenance have also been recognised, and the use of a computerised preventative maintenance system is likely to be a future development in this area.

10.5 Monitoring and Targeting (M&T)

David Holdsworth initially set up a manual (pen and paper based) energy monitoring system, and later improved on this by the use of his own spreadsheet based software.

In recent years he made particular use of the CUSUM technique (Ref 2), to identify changes in energy consumption, which were then investigated and appropriate action taken. He also used CUSUM to monitor his own performance against an ongoing annual target of 5% reduction in energy consumption.

David considers CUSUM to be one of the simplest statistical techniques for managing any resource and has successfully used it for several non-energy related variables, including defect rates in the finished product.

To assist his single-handed approach to energy management, he recently installed twelve pulsed electricity meters in key areas of the site. This enabled the input of electricity consumption data directly to his M&T software, enabling him to check the consumption of

each area with the expected norm, within a few minutes each day. David considers the time saving to be worthwhile and the fast response will soon yield saving through quick identification of adverse variances.

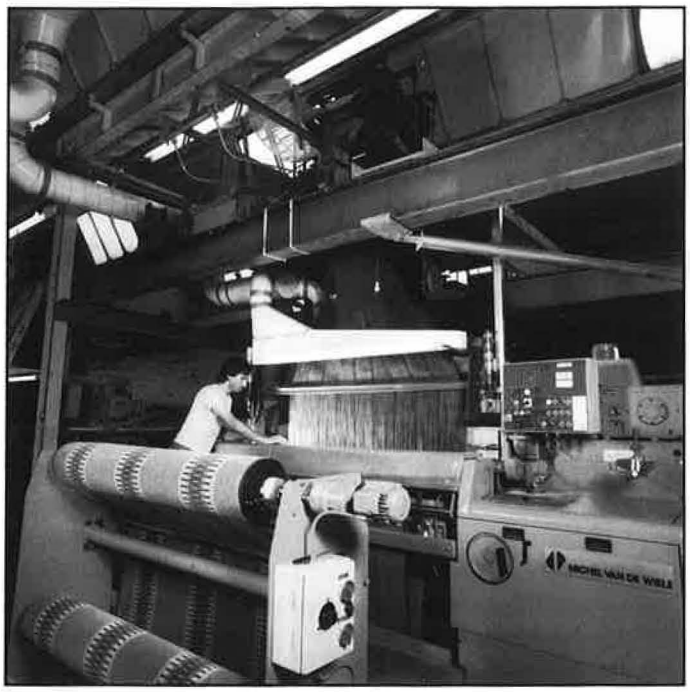


Fig 20 The weaving process

10.6 Financing of Energy Saving Schemes

Initially David Holdsworth spent 5% of his energy budget on improving efficiency. This enabled him to implement many of the low cost schemes identified in the original energy audit. Subsequently, all energy saving schemes were funded from savings already achieved.

David presently applies the criteria of investing 25% of the previous year's savings in new schemes, with 50% paying off the previous year's investment and remaining 25% converted directly into profit. This approach has led to the implementation of many energy saving schemes, too numerous to include on this case history, including the continual upgrading of the sites Building Energy Management system. He considers this provides the right balance between energy efficiency, generating finance for investment and generating immediate profit.

10.7 Summary

Since 1978, David Holdsworth has reduced the Company's energy consumption by over £100,000/year, a remarkable 50% cost saving, and he is committed to achieving further savings.

He has maintained an awareness of developments in technology and energy management techniques through courses and seminars. Critical examination of all areas of the site's energy consumption and an openness to communication regarding energy efficiency opportunities has led to the progressive implementation of many energy saving schemes, each being financed from previous savings.

11. REFERENCES

1. Preparing the Company Energy Plan — Peter Harris
   Cheriton Technology Publications.

2. Energy Monitoring and Target Setting — Peter Harris
   Cheriton Technology Publications.

3. Employee Participation in Energy Saving Programmes — Grafton
   Energy Publications.

4. Training Staff to Cut Energy Costs — Peter Heslop
   Energy Publications.

5. Directors' Guide to Energy Management
   The Director Publications Limited.

6. Investment Appraisal for Managers:A Guide to Project Planning - 2nd Edition
   Aldershot, Gower 1987. — Graham Mott

7. Project Management for Raw Material Preparation Plant Introducing the Life Cycle Concept
   London 1987. — H Darnell

8. Achieve Total Quality
   Cambridge, Director Books 1992. — David Hutchins

9. Total Quality: Success through People;
   Institute of Personnel Management, London 1989. — Ron Collard

10. Managing Quality
    New York, Philip Allen 1990. — BG Dale & JJ Plunkett

11. CIBSE Applications Manual AM5
    Contract Energy Management 1991.

12. Third Party Financing Opportunities for Energy Efficiency in the European Community
    Report by ACE under contract to the commission of European Communities, Publication No. EUR 10525 1986.

13. Third Party Financing for Energy Savings
    Commission of European Communities 1988.

14. For information on Monitoring and Targeting refer to the following which are available from the Energy Efficiency Office:

    - Energy Efficiency Booklet - Series 8.

    - The Application of Monitoring & Targeting to Energy Management (for industrial sectors).

    - Energy - Containing the Costs.

    - Good Practice Guide No. 31 - Computer Aided Monitoring & Targeting in Industry.

15. For details of the latest and forthcoming Best Practice programme publications on Energy Management, contact the :

Energy Efficiency Enquiries Bureau,
ETSU,
Harwell,
Oxfordshire
OX11 0RA

Tel No. 0235 436747
Fax No. 0235 432923

15. For details of the latest and forthcoming Best Practice programme publications on Energy Management, contact the :

Energy Efficiency Enquiries Bureau,
ETSU,
Harwell,
Oxfordshire
OX11 0RA

Tel No. 0235 436747
Fax No. 0235 432923

Energy Efficiency Office

DEPARTMENT OF THE ENVIRONMENT